Space Weather Technical Forecast

Issued on Wednesday, 10 November 2021 at 12:34 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity was at moderate levels, with a long duration M2 flare peaking at 09/1703 UTC from AR2891 behind the west limb. A large associated CME was evident in coronagraph imagery, but no Earth-directed component exists after analysis. No further Earth-directed CMEs were obvious in available imagery.

There are currently three sunspot regions visible, with AR2893 in the northwest and AR2894 in the southeast (both Hsx/Alpha) persisting as simple uni-polar spots. AR2895 (Dro/Beta) in the northeast saw some penumbral decay in its leading and trailing spots, now classed as rudimentary, with waxing and waning of several weak intermediate spots.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR was at slow-ambient levels between until 10/0130 UTC when it became slightly elevated with a maximum of 450 km/s. Density values were above average between 09/1845-10/0230 UTC but were otherwise average or below. Total IMF Bt was weak at 3-6 nT, with an unremarkable north-south component Bz of +/- 6 nT. Phi angle remained in a predominantly positive (away from sun) direction. Resultant geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16, increased after 09/1800 UTC in response to the M-class flare, but remained below the S1/Minor Storm level. The high energy electron flux (greater than 2 MeV) reached high levels through the diurnal oscillation, peaking at 2260 pfu at 09/2025 UTC. The 24-hour integrated fluence was just above the Active threshold, before falling below by 09/1800 UTC, and with 8.63e7 integrated pfu recorded at 10/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be very low, with a chance of C-class flares, and a slight chance of M-class flares, mainly on day 1 (10th) from a region behind the west limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected, however up to two slow and weak CMEs could just give a weak glancing blow, most likely on day 2 (11th), but with minimal impacts expected. Generally slow-ambient solar winds expected through the period, but with some slight enhancements possible from weak coronal holes and possible CME effects. Geomagnetic activity is expected to be Quiet to Unsettled, with a low risk of Active intervals, mainly from day 2.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to soon return to background levels as the effects of the recent M-class flare wane. The high energy electron flux (greater than 2 MeV) is likely to continue to peak at high levels through the next few days, although with a slowly declining trend. 24-hour electron fluence is expected to continue on a downward trend, below the Active (1e8 integrated pfu) threshold.

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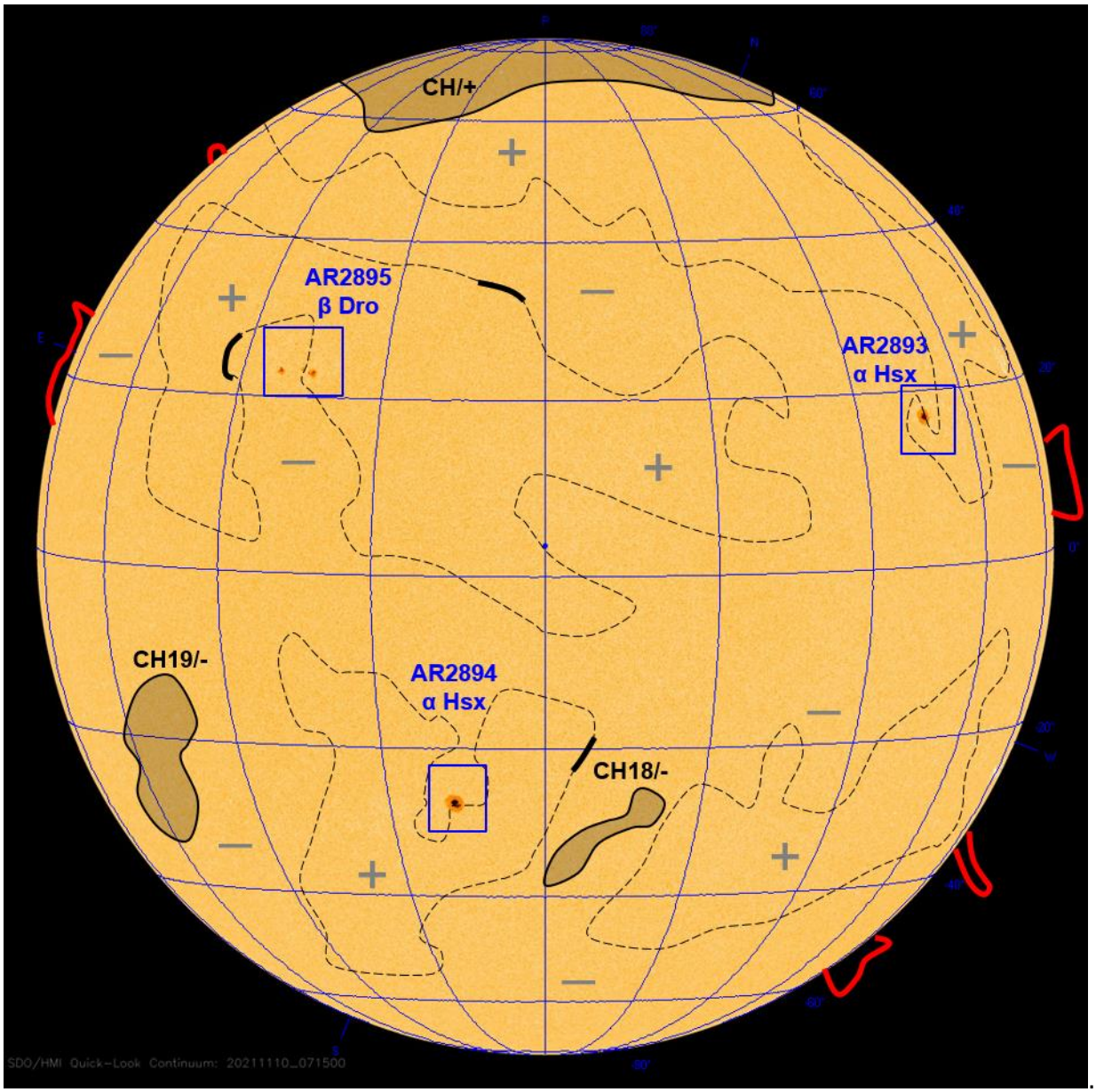
Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

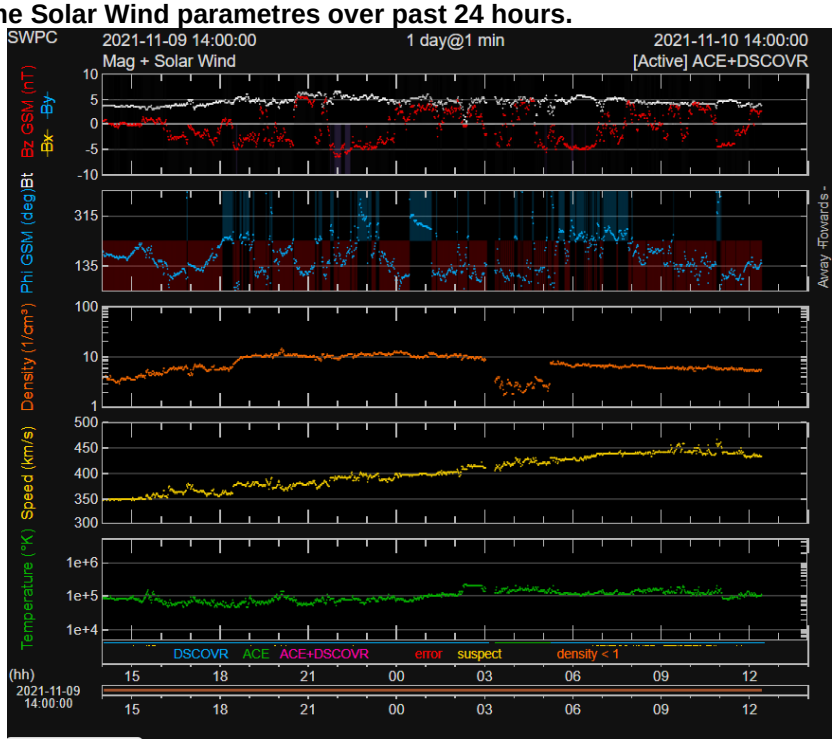
The results for the CME associated the M2 flare on 9th came back with no Earth-directed element. No other Earth-directed CMEs are currently expected, however up to two weak CMEs are expected to pass ahead of Earth. A weak glancing blow is just possible, most likely on day 2 (11th) if it occurs, as hinted at by a small number of MOSWOC Enlil ensemble members. Both CMEs are relatively slow and weak, with any potential impacts likely to be minimal.

Solar wind speeds are at slow ambient levels, but some slight enhancements are possible through the period. These perhaps from weak coronal hole effects from the remnants of CH17/-, not now visible in the west, and perhaps from small CH18/- in the southeast later in the period. Some slight enhancements would also be expected if any of the above mentioned CME effects materialise.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, with a low risk of Active intervals, mainly from any possible weak CME influence on day 2.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Real Time Solar Wind parametres over past 24 hours.



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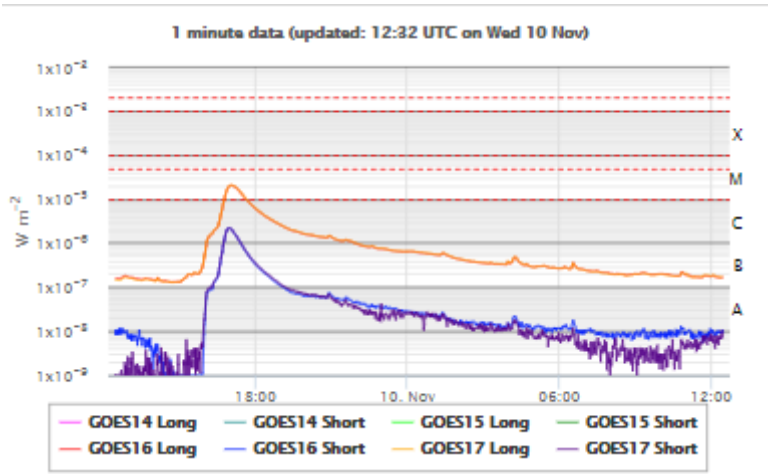
Radio Blackouts - X-Ray Flares:

There is a slight chance of further M-class flares, mainly early in the period from a sunspot region now out of view around the west limb. Otherwise, generally very low solar activity expected, with currently three magnetically simple regions visible. Of these, AR2895 (Dro/Beta) in the northeast gives the greatest potential for any flare activity, although it has continued to show simplification.

Current far side STEREO EUVI imagery would suggest no further significant active regions likely to move into view through the next four days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	10	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray trace past 24 hours (long period M-Class)



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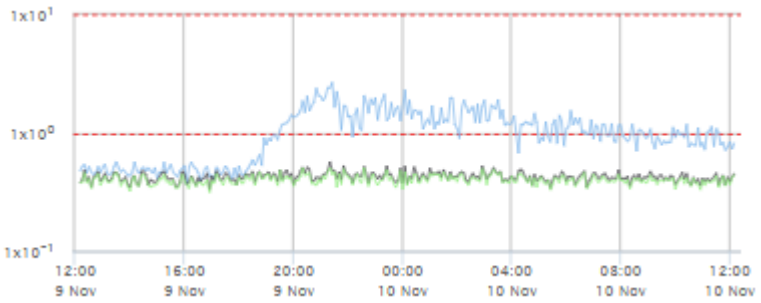
Solar Radiation Storms - (High Energy Protons):

No solar radiation storms are expected, but an M2 flare from a sunspot region behind the west limb elevated the high energy proton flux (greater than 10 MeV) at GOES-16 from late on 9th Nov. Levels have remained well below S1/Minor Storm levels, and are continuing on a slow trend back to background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton trace past 24 hours



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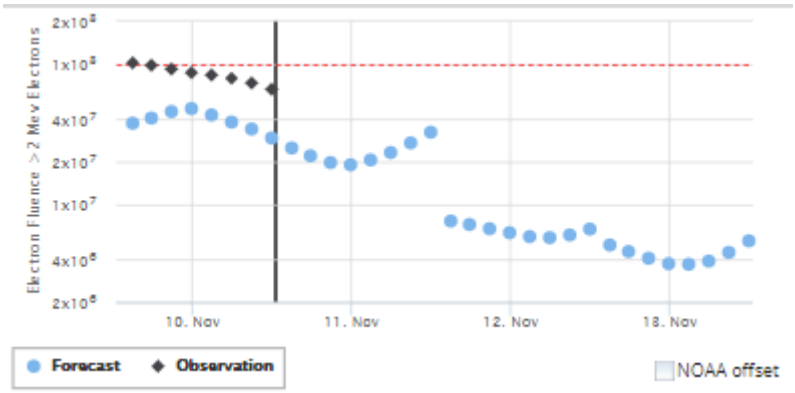
High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux at GEO is starting at moderate levels, but with a likelihood of reaching high levels during the diurnal max. However, this is low confidence, with further effects from coronal hole/weak CMEs possible over the coming two days.

The associated 24-hour electron fluence is currently below the Active threshold, and is likely to see a continuing slow downward trend, perhaps with an uptick late in the day or into day 2 as flux levels rise in the diurnal max. However, this remains low confidence, due to the weak coronal hole and weak CMEs over the coming two days. The overall trend pattern of the REFM forecast data seems reasonable but with a higher starting point as seen in the observed fluence data.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	40	40	30	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM observed and forecast fluence (24 hour integrated flux)



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